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# The Economic Role of Range Livestock Production in Kasungu Agricultural Development Division (KADD), Malawi

Phillip H. W. Phiri
*Utah State University*

# THE ECONOMIC ROLES OF RANGE LIVESTOCK PRODUCTION IN KASUNGU AGRICULTURAL DEVELOPMENT DIVISION (KADD), MALAWI

by

Phillip H. W. Phiri

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# ABSTRACT

The Economic Role of Range Livestock Production in Kasungu Agricultural Development Division (KADD), Malawi

by

Phillip H. W. Phiri, Master of Science

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Major Professor: Dr. John P. Workman
Department: Rangeland Resources

This study was conducted to determine the effects of season and auction and produce marketing systems on prices received by farmers for livestock sales and the effect of price on cattle numbers sold in KADD. Livestock population, carrying capacity, and stocking rate were estimated. Data were analyzed using pie charts, regression methods, and analysis of variance.

There was no significant difference ($P=.06$) between cattle prices per kilogram during the wet season and after harvest. During the wet season, significantly more cattle were sold than after harvest ($P<.001$) to purchase food and

farm inputs, and pay school fees and medical bills. Market price was only a secondary factor.

Carrying capacity and stocking rate were estimated at 15.00 kg metabolic mass per hectare and 12.00 kg metabolic mass per hectare, respectively.

Most households primarily sold male cattle because females are retained for breeding.

(107 pages)

## DEDICATION

To my brother Ishmael Michael Phiri (deceased) for his kindness and love, which he shared with me. In addition, he was my inspiration. He also financed my education from primary school up to the University of Malawi.

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Phillip H.W. Phiri

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# INTRODUCTION

In order to define the economic role of range livestock production in Malawi, separate definitions of the terms economics and range livestock production will be provided. Workman (1986) defined economics as the science that deals with efficient allocation of scarce resources among competing uses. Resources include labor, capital, arable land, and grazing land. The primary scarce resource for range livestock production in Kasungu Agricultural Development Division (KADD) is grazing land. The competing uses are crop production and rural residences competing with livestock for grazing land. Range livestock production in Malawi refers to keeping of ruminant animals on native pastures along rivers and on uncultivated fields, mountains, crop residues, and forests. Animals are herded at all times during the wet season and corralled at night. After harvest they graze freely without a herder and sometimes spend nights outside corrals. This pattern is common in central and southern Malawi, in contrast to northern Malawi where herding occurs throughout the year. Livestock owners practice communal grazing even though

animals are privately owned. Crotty (1990) noted that communal grazing in which small, individually owned herds forage on the same land provides the most economically productive and most politically stable method of exploiting grazing land by pastoralists. Livestock production in Malawi, however, is not considered an independent major enterprise, but only a supplemental enterprise to crop production. This implies that a livestock owner's major occupation is crop production either for subsistence or sale of surplus.

Range livestock production plays a small but important role in the livelihood of Malawians. It provides nutrition and income to individuals and the nation. Range livestock are the major suppliers of meat. The supply is far from satisfactory, however. Per capita meat and milk consumption is estimated at 3 kg and 5.5 kg per annum, respectively (Kumwenda and Kunkwezu 1987), as compared to 56.5 kg and 108.2 kg per capita consumption of meat and milk consumption, respectively, in the United States of America (Putnam and Allhouse 1994). Meat or live animals are also sold to obtain cash. In addition, hides from livestock are

exported for foreign exchange. I will detail the economic role of range livestock production to producer households.

**Economic Role to Individuals**

Range livestock are important to households in two ways: they supply cash and non-cash benefits. Range livestock bring cash to range livestock farmers through the sale of meat or live animals and renting out draft oxen. Farmers sell their animals to the cold storage company, local produce markets, and cattle dealers to obtain cash (Tables 1 and 2). Cold storage and cattle dealers buy livestock from auction markets. Some farmers sell their livestock at the homestead because they are desperately in need of money. Traders may take advantage of the situation and earn an excessive level of profits through their ability to exploit their monopoly position and farmers' ignorance of the value of their livestock and products. Herman (1981) argued, however, that pastoralists are aware that they get higher prices for their livestock at markets than at their homestead, but nevertheless they sometimes choose to save time and get money quickly in preference to the higher price. Farmers also obtain extra cash by renting

**Table 1. Net returns from steers issued to KADD on government loan. (The steers are issued to farmers by government on loan; in return farmers pay back the principal and interest)**

| Year | Total number of steers issued | Net returns/steer (MK) |
|---|---|---|
| 1988 | 333 | 135.00 |
| 1989 | 431 | 175.00 |
| 1990 | 462 | 200.00 |
| 1991 | 707 | 242.00 |
| 1992 | 538 | 250.00 |

Source: Anonymous (1993)

**Table 2. Net returns from lambs issued to KADD on government loan. (lambs are issued in the same manner as steers in table 1)**

| Year | Total number of lambs issued | Net returns/lamb (MK) |
|---|---|---|
| 1988 | 85 | 37.00 |
| 1989 | 59 | 32.00 |
| 1990 | 50 | 41.00 |
| 1991 | 44 | 39.00 |
| 1992 | 46 | 42.00 |

Source: Anonymous (1993)

out oxen for cultivation and transportation of goods. Work oxen are the predominant source of power for cultivation in northern Malawi. The use of tractors is not economical because farmers have less than 5 hectares of land, on average, for crop production. Another common use of oxen is to transport heavy goods [e.g., farm inputs from markets to homesteads and farm produce from homestead to markets (Mwinjiro 1987)].

An important contribution of livestock to Malawi's population is provision of cash throughout the year. It is therefore common for farmers to keep livestock as an investment and sell them only when cash is needed [e.g., to pay for school fees (secondary and university) and hospital charges]. In contrast, crop production provides income once a year and within a short time period, so farmers are attracted more to crop farming than earning small amounts of money distributed over the year from livestock. Another important contribution of livestock, particularly cattle, goats, and chickens, is that they are used in functions like marriages, funerals, and celebrations instead of cash. When a woman marries, her family is offered livestock (usually cattle) by the groom's family as dowry. The livestock number differs from district to district, but ranges from 4 to 10 head of cattle per bride. This is not common in central and southern Malawi, where they practice a matrilineal system of marriage (when a husband stays at the bride's home after marriage). In this case, the bride price is very low or negligible. Instead of spending money to buy meat at funerals, goats are commonly slaughtered.

Chickens are slaughtered for special guests, when a bridegroom visits the bride's home in the patrilineal system, and where husband and wife live at a different location from the bride's home, elsewhere.

**Economic Role to the Nation**

Malawi's economy is agriculturally based, as 52% of the gross domestic product (GDP) comes from agriculture (Nkhonjera 1990 ). Of the 52% of GDP, about 50% comes from tobacco, 25% from tea, and 10% from sugar. At present, the livestock sector contributes about 8% to overall GDP (Malawi Economic Report 1987). All meat and animal products are consumed locally except for hides and skins, which are exported for foreign exchange.

**Nature of the Problem**

There are a number of problems that limit the economic benefits from livestock. They include reduced levels of production, sale of animals when market prices are low, and inadequate research recommendations appropriate to the level of farmers' knowledge and resource endowment. Problems discussed below are universal for Malawi. Specific

reference will be made, however, for the area under consideration. The area is called Kasungu Agricultural Development Division, referred to as KADD. This is one of eight Agricultural Divisions (see Figure 1).

## Reduced Levels of Production

Farmers do not realize potential economic benefits from range livestock because of low levels of animal production. Production includes productivity and reproductivity. Productivity means production per unit of time, usually in terms of weight gains per day, and reproductivity refers to conception rate. Productivity of livestock in the tropical and subtropical regions of Africa, Asia, Latin America and Australia is generally low when expressed on a per capita basis (Butterworth 1985). The reason for this low productivity is predominantly quantity and quality of available forage. Consequent nutritional, seasonal differences in precipitation cause wide fluctuations in both deficiencies are often exacerbated by poor nutrient status of many tropical soils.

Low quality forage. Predominant sources of feed in

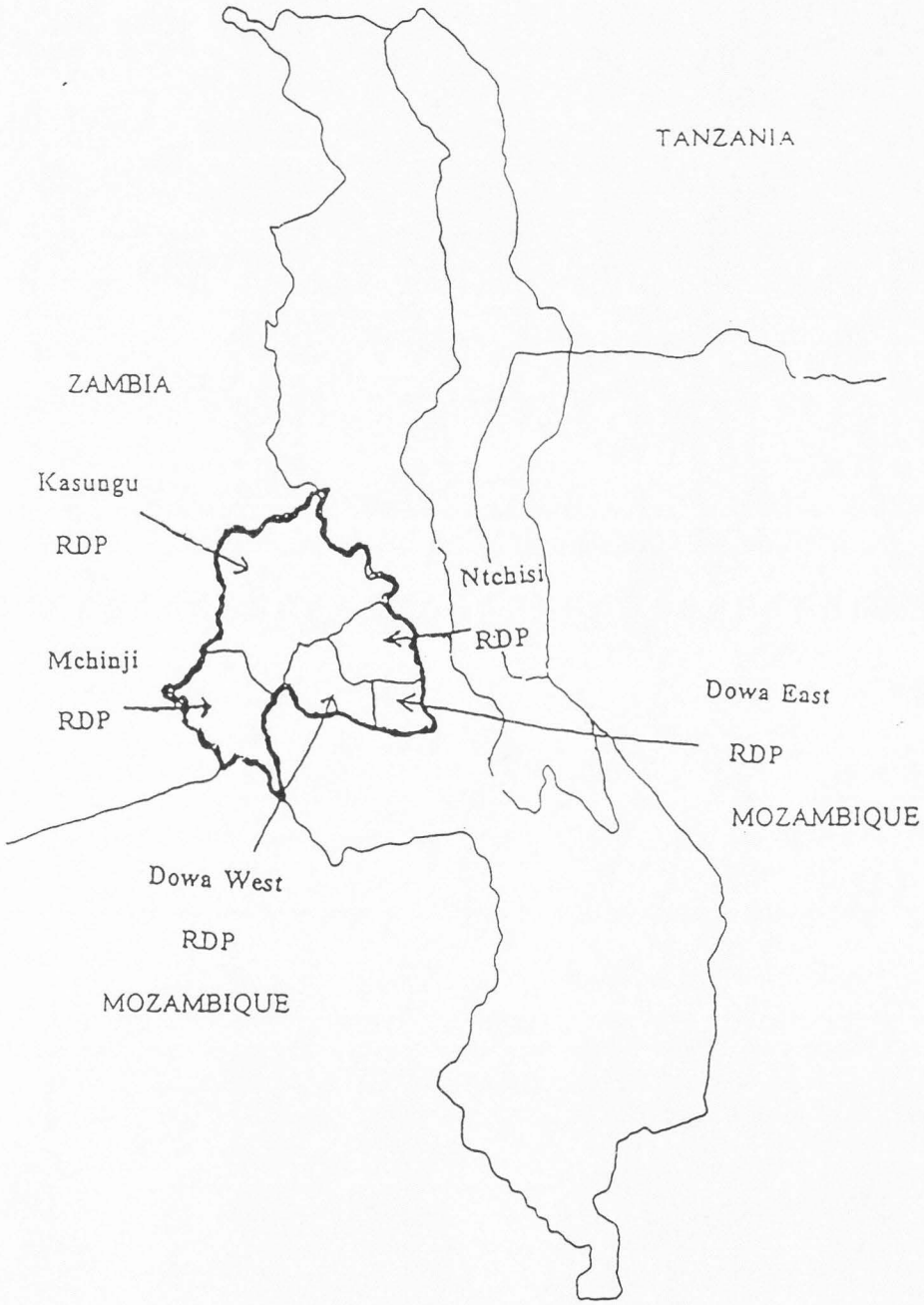



**Fig. 1. Map of Malawi showing the boundaries of KADD and rural development projects.**

Malawi are natural forage and crop residues. Natural forage is the cheapest source of animal nutrition (Msiska 1989). It grows on upland and riparian areas. Upland forage is characterized by being relatively higher than riparian areas. Rainfall pattern is unimodal starting in November and ending in April. It follows that quality is high from November to January. Quality is positively correlated with rainfall pattern. At the beginning of rainy season, forage quality is high but declines as plants mature. An important source of forage is found along river banks. The depletion of upland vegetation intensifies the natural tendency of livestock to concentrate on river banks (Chaney and Platts 1991). The presence of water and green vegetation makes riparian areas attractive and important to domestic livestock grazing adjacent to drier uplands. Although the government's policy is to graze along river banks during the dry season to prevent animals from internal parasite infestation (liver fluke), grazing occurs in the riparian areas during both the rainy and dry seasons. The larval stage of liver fluke attaches itself to grass during rainy season in riparian areas. This becomes the source of

parasite infestation. Livestock concentrate in the riparian areas because, among the numerous factors that influence the way livestock graze a range, none is more significant than the nutritive quality and palatability of the forage (Chaney and Platts 1991). As a result, most of riparian areas are overstocked because an individual owner reaps the full benefit of additional animals, while the cost in pasture, water, and eventual range degradation due to overgrazing is shared by all households and future households (Evangelou 1984). The plane of nutrition improves again after harvest in the months of April and May because livestock feed on crop residues that are left in the field for anyone to graze his/her livestock at no cost. Low-quality forage also reduces reproduction. From my observation, some cattle calved after 3 years from the previous parturition. Conception rate is relatively higher after harvest than at any other period because animals feed on crop residues and herds with bulls mix freely with herds without. Animals benefit from ground nut tops and maize grain that have fallen on the ground when harvesting.

Reduced customary land. The land tenure is divided

into customary land and estate land. Customary land is land under jurisdiction of traditional chiefs, while estate land is privately owned. Customary land is communally owned, and hence every person in the village has the right to use it for settlement, cultivation, and grazing. Tables 3 and 4 show the proportion of customary land in 1984/85 and 1988/89. It was reduced from 1,067,750 ha in 1984/85 to 782,468 ha in 1988/89. The major cause of this reduction has been an increase in human population. The national population has been estimated at eight million with an annual population growth of 3.7% (Anonymous 1987). For KADD the growth rate was 3.9% (Anonymous 1987). Human population pressure and expansion of estates are forcing many farmers to cultivate increasingly marginal lands and to overstock grazing lands (Kreuter 1992). More land is being opened for cultivation to feed additional people and grazing land is being reduced. An increase in human population implies, however, that demand for meat and other animal products also increases. We would expect that where the livestock: person ratio is low, because of subsistence consumption needs, this, along with the high availability of herders,

**Table 3. Estimated land use distribution in KADD, 1985.**

| | Rural Development Projects | | | | | |
|---|---|---|---|---|---|---|
| Land use | Kusungu | Ntchisi | Dowa West | Dowa East | Mchinji | Total |
| Customary Land(ha) | 376,328 | 154,048 | 160,526 | 133,577 | 243,271 | 1,067,750 |
| Land Registered as Estates (ha) | 174,111 | 5,512 | 14,174 | 2,984 | 91,329 | 298,110 |
| Parks Forest Reserve Dambo (ha) | 90,670 | 18,532 | 16,163 | 34,966 | 76,861 | 237,282 |
| Total Area (ha) | 550,439 | 269,550 | 174,700 | 136,551 | 334,600 | 1,365,860 |

Source: Nanthambwe and Eschweiler (1992)

**Table 4. Estimated land use distribution in KADD, 1992**

| | Rural Development Project | | | | | |
|---|---|---|---|---|---|---|
| Land use | Kasungu | Ntchisi | Dowa East | Dowa West | Mchinji | Total |
| Customary Land(ha) | 162,505 | 142,493 | 104,554 | 146,838 | 226,078 | 782,468 |
| Land Registered as Estates (ha) | 384,405 | 15,990 | 6,703 | 30,557 | 66,294 | 503,135 |
| Parks, Forest Reserve and Dambo(ha) | 250,592 | 21,168 | 4,743 | 2,555 | 19,378 | 298,135 |
| Total Area (ha) | 797,502 | 179,650 | 116,000 | 179,650 | 311,750 | 1,584,550 |

Source: Nanthambwe and Eschweiler (1992)

brings an incentive to increase herd size. Increasing herd size may be particularly difficult since grazing land is being reduced. Tables 5 and 6 show livestock numbers estimated for KADD in 1991 and 1992. There was a drop in cattle and sheep, while there has been an increase in goats.

Sale of Animals When Prices Are Low

One of the features of African pastoral systems is that the flow of livestock products through marketing channels fluctuates widely among seasons and across years (Sandford 1983). What is speculated to occur is that after harvest in Malawi, farmers appear to have enough food and cash from crop sales and, therefore, do not need to sell animals. Prices of livestock go up because few animals are offered for sale. Compared to after-harvest sales, more animals are sold during the growing season to raise cash to purchase food and pay for necessities like school fees and hospital charges. Supply of animals at market increases and demand for meat is reduced since the money earned from crop sales has been used up, so livestock prices go down. This

**Table 5. KADD annual livestock census figures for 1992**

| RDPs[1] | Bulls | Steers | Cows | Calves | | Total Cattle | Goats | Sheep |
|---|---|---|---|---|---|---|---|---|
| | | | | Male | Female | | | |
| Dowa East | 1,107 | 2,622 | 12,219 | 1,732 | 1,434 | 19,214 | 27,176 | 789 |
| Dowa West | 1,855 | 5,685 | 23,368 | 4,929 | 5,554 | 41,391 | 30,472 | 5,264 |
| Kasungu | 1,877 | 6,928 | 12,894 | 2,204 | 2,591 | 26,124 | 19,750 | 2,139 |
| Mchinji | 1,385 | 5,751 | 13,594 | 2,712 | 2,739 | 26,181 | 42,217 | 161 |
| Ntchisi | 1,171 | 2,853 | 9,485 | 1,822 | 1,902 | 7,233 | 20,780 | 3,114 |
| Subtotal | 7,395 | 23,839 | 71,560 | 13,399 | 14,220 | 130,143 | 140,395 | 11,467 |
| Estates | | | | | | | | |
| Kasungu | 44 | 344 | 1,024 | 169 | 189 | 1,784 | 214 | 610 |
| Mchinji | 30 | 125 | 477 | 28 | 41 | 710 | 309 | 157 |
| Subtotal | 74 | 469 | 1,510 | 197 | 230 | 2,494 | 523 | 767 |
| Grand Total | 7,469 | 24,308 | 73,061 | 13,596 | 14,450 | 132,637 | 140,918 | 12,234 |

Source: Anonymous (1993)

**Table 6. KADD annual livestock census figures for 1991**

| RDPs[1] | Bulls | Steers | Cows | Calves | | Total Cattle | Goats | Sheep |
|---|---|---|---|---|---|---|---|---|
| | | | | Male | Female | | | |
| Dowa East | 953 | 2,976 | 15,384 | 1,975 | 2,182 | 23,472 | 27,262 | 2,617 |
| Dowa West | 1,999 | 5,230 | 23,569 | 5,054 | 5,625 | 41,477 | 28,953 | 6,073 |
| Kasungu | 1,968 | 6,603 | 1,946 | 1,946 | 2,158 | 25,584 | 18,189 | 2,793 |
| Mchinji | 1,381 | 5,598 | 12,998 | 2,465 | 2,642 | 25,084 | 37,092 | 182 |
| Ntchisi | 1,149 | 2,868 | 1,958 | 1,724 | 1,828 | 16,727 | 19,113 | 3,471 |
| Subtotal | 7,450 | 23,275 | 74,018 | 13,164 | 14,435 | 132,344 | 130,609 | 15,146 |
| Estates | | | | | | | | |
| Kasungu | 111 | 806 | 1,235 | 235 | 252 | 2,639 | 181 | 792 |
| Mchinji | 20 | 62 | 240 | 42 | 45 | 410 | 128 | 23 |
| Subtotal | 131 | 868 | 1,475 | 277 | 297 | 3,049 | 309 | 815 |
| Grand Total | 7,581 | 24,143 | 75,493 | 13,441 | 14,732 | 135,393 | 130,918 | 15,951 |

Source: Anonymous (1993)

[1] Rural development projects

happens during the growing season. The problem here is that farmers get less for their animals because they are sold at a time when prices are low. Simpson (1988) explained that while economists expect a positive relationship between price and the quantity offered, social anthropologists often use the concept of target income which, once achieved, a pastoralist sees no reason to surpass it. Instead he will reduce the numbers of animals he sells if higher prices enable fewer animals to achieve his target income--the so-called "perverse" supply curve.

## Insufficient Research Recommendations

The performance of livestock production in Malawi as part of agriculture appears low. While crop production has made a lot of progress in coming up with appropriate agronomic innovations, animal scientists have lagged behind. Jahnke (1982) reported that although there have been productivity gains in a number of specific situations, most of them have been achieved under management conditions that are beyond the level of knowledge and means of the majority of livestock producers.

**Possible Solutions**

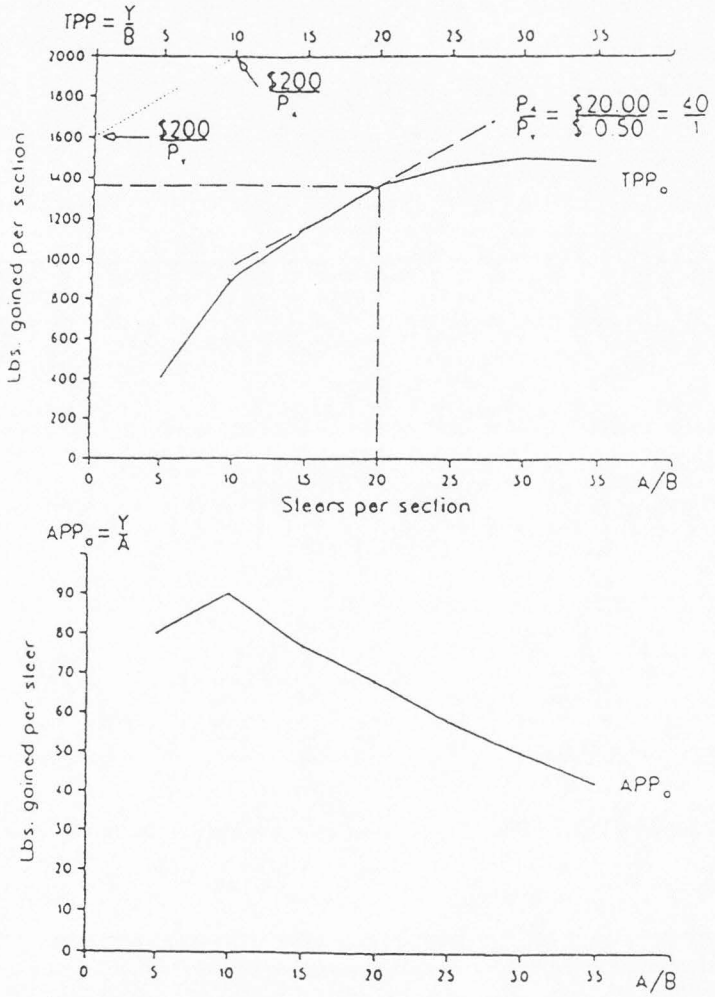
In order to obtain increased economic benefits from range livestock, owners should maintain an optimal stocking rate, sell their animals when prices are higher, and integrate livestock and crop production. In addition, research should focus on solving farmers' problems using the available resources. I will focus my work in this thesis on maintaining an optimal stocking rate and selling animals when prices are favorable.

Maintaining an Optimal Stocking Rate

Increased economic benefits may be obtained if livestock production is increased. Increased livestock production is achieved by providing the animals with adequate nutrition. As discussed above, sources of feed are natural forage and crop residues. In order to meet animal nutritional requirements, stocking rate must be adjusted to the quality and amount of feed available. Stocking rate is the actual number of animals or animal units on a unit of land for a specific period of time, usually for a grazing season (Heady and Child 1994). Adjustments of numbers can be done if carrying capacity is known. Carrying capacity is

defined as the average number of livestock and/or wildlife that may be sustained on a management unit compatible with management objectives for the unit (Task Group on Unity 1995). Stocking rate is the principal factor affecting the relative success of any grazing management strategy because number of animals affects not only individual animal performance but also production per unit area of land. To estimate carrying capacity, the quantity of natural forage, crop residues, and industrial by-products must be considered in Malawi since they form a major component of animal feed.

Figure 2 represents a sustained-yield production function such as what might be estimated by long-term research on grazing intensity (Workman and Lacey 1982). It shows that an increase in number of steers increases total physical product (TPP). The increase is first at an increasing rate, then at a decreasing rate to a point of maximum. Further increases in steer numbers result in a decrease in total production. At low stocking rates, average physical product (APP) is maximized because grazing pressure is low. As stocking rate is increased, APP




TPP stands for total physical product
APP stands for average physical product

**Fig. 2. Hypothetical production function, inverse price line, and optimum stocking rate for grazing 640 acres of rangeland.**

Source : Workman (1986, p. 53)

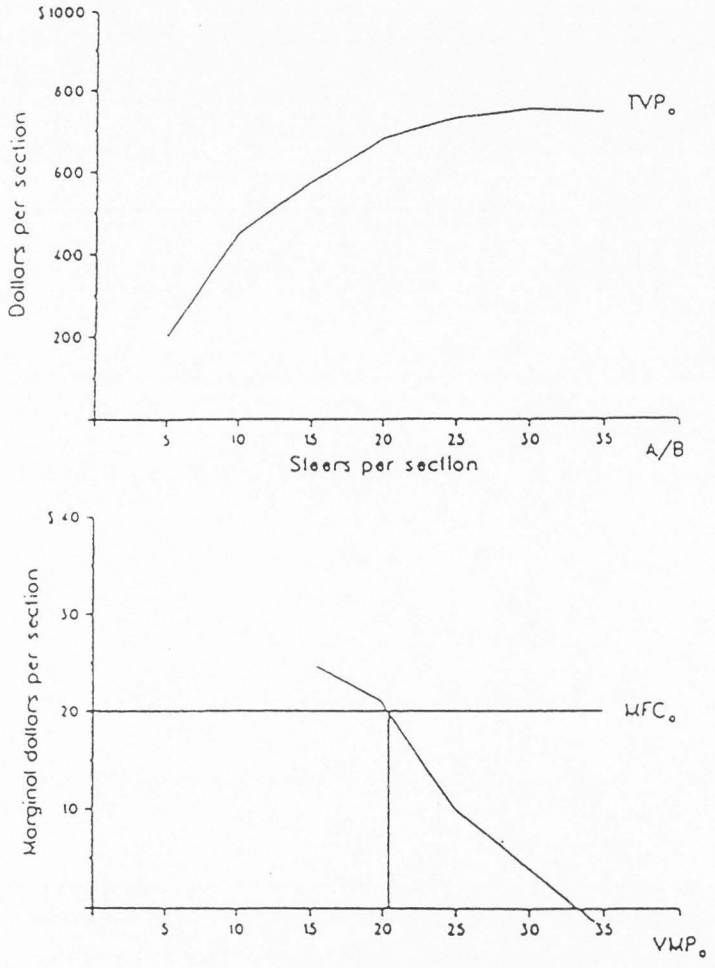
decreases while production per unit area of land increases to some maximum and then declines. From this figure, we can be confident that 30 steers can be grazed year after year on 640 acres for 2 months and an average gain of 1,500 pounds will result. A stocking rate of 35 steers per section, however, will lead to an average gain of only 1,480 pounds. The sustained yield decrease is due to forage competition among animals and long-term damage to vegetation and soil. Determining optimum stocking rate is magnified by the problems of climate variation and selective grazing. Climate varies in both space and time and influences the optimal grazing intensity that maximizes net returns. Therefore, the appropriate stocking rate to attain optimal harvest and conversion efficiencies also varies within and among years. Regardless of vegetation complex or the kind or class of animal, stocking rate has a profound effect on livestock production because it determines forage demand and subsequent forage availability (Heitschmidt et al.1985). Improving pastoral productivity is often conceived in terms of improving output per head of livestock, with emphasis on calving rates, milk yields, and

daily weight gains (Sandford 1983). On the contrary, concern should be on maximizing benefits.

Figure 3 shows that increasing the number of steers increases the total value product (TVP) to a point of maximum, and then further increases in steer numbers decrease the TVP. An additional number results in decreasing the value of marginal product (VMP). Maximum profit is achieved at a point where VMP equals marginal factor cost (MFC).

### Selling Excess Animals When Prices Are High

Livestock owners must be encouraged to sell excess animals. From the discussion above, livestock prices at auction markets are higher soon after harvest and lower during the growing season. Soon after harvest, livestock are in good condition because they feed on forage from riparian areas and crop residues, which are depleted after 2 months. Livestock owners would therefore increase their livestock revenues by selling their animals as soon as crop residues are depleted. This would allow fewer numbers of livestock for the limited feed during the growing season.




TVP stands for total value product
VMP stands for value of marginal product
MFC stands for marginal factor cost

**Fig. 3. Derivation of VMP curve from TVP and determination of optimum input by equating VMP and MFC.**

Source: Workman (1986, p. 75)

Unlike auction markets, prices of meat per kilogram at produce markets are determined by a district committee consisting of livestock dealers, livestock owners, consumers, and the government. The price is different from one administrative district to another. However, it is constant throughout the year and is the same regardless of grade. The only meat categories are steak and meat with bones. In order to increase livestock revenues and improve the quality of meat and meat products, different grades should be distinguished at produce markets so that price is influenced by supply and demand for each grade. Price of meat is an extremely important factor in livestock raising systems. If meat prices are low, livestock owners cannot afford to buy as many inputs as when prices are high (Simpson 1988).

**Relevance**

This project will provide the government and farmers with practical economic information regarding increased economic benefits. It will also be of interest to researchers in determining the direction of future efforts in livestock research. As mentioned earlier, if human

population continues to grow rapidly and exceeds the ability of the area to support the population by the communal grazing method, then priority should be given to creating additional opportunities for earning a livelihood through intensive systems of production.

## OBJECTIVES AND HYPOTHESES

Objective A) Describe range livestock production in KADD, including average herd and flock sizes, carrying capacity, stocking rate, and the relative importance and marketing rationale for each species of livestock.

Objective B) Determine effects of marketing systems and seasons on prices received by farmers for livestock sales and effect of price on cattle numbers sold.

Hypotheses for Objective A:

$H_o1$: Stocking rate will exceed carrying capacity for KADD for 1995.

$H_o2$: Goats, cattle, and other ruminant livestock are similarly regarded in terms of their economic importance to households.

$H_A2$: Goats are regarded more favorably than any other livestock species, primarily because of their convenient size and rapid reproduction rates.

$H_o3$: The marketing rationale for farmers is to

supply animals to market primarily in response to price. When the price is higher, farmers want to supply more animals.

$H_A3$: The marketing rationale for farmers is to supply animals to market to solve immediate cash flow problems; price is only a secondary factor. When cash flow needs are higher, farmers need to sell more animals.

Hypotheses for Objective B:

Effects of Marketing Systems

$H_O4$: There are no effects of marketing systems on prices; prices at produce markets will equal those at auction markets in all cases.

$H_A4$: Auction markets will always yield a higher price to farmers than produce markets, regardless of animal supply, species or season. This is because people who buy animals at auction markets sell meat at places where the price is high (e.g., commercial super markets).

Effects of Season (including change in environment and cash flow needs) on Prices

$H_o5$: Animal supply to market regardless of marketing systems, is highest during the wet season because this is the time households need cash to buy food.

$H_A5$: Cattle numbers sold at the market is the same during wet and dry season, regardless of marketing systems.

Effects of Prices on Cattle Numbers Sold

$H_o6$: When prices are higher, farmers will supply more animals to market regardless of marketing system and season.

$H_{A1}6$: There are no effects of prices on cattle supply to market, regardless of marketing system and season.

$H_{A2}6$: When prices are lower, farmers will supply more cattle to market, regardless of marketing system. High supply thus coincides with seasons in which cash flow problems are paramount.

# METHODS

## Study Area

Data were collected in KADD from September 1995 to April 1996. KADD is located in Central Malawi (Figure 3). It consists of four administrative districts of Kasungu, Mchinji, Dowa, and Ntchisi. However, it has five rural development projects (RDPs), namely, Kasungu, Mchinji, Dowa East, Dowa West, and Ntchisi. The RDPs are divided into 24 extension planning areas (EPAs), which are further subdivided into sections. Sections are used for general extension.

KADD has uniform agro-ecological features in terms of soils, rainfall distribution, topography, and temperature. Soils are mostly clay loams, which are good for cultivation of crops. KADD produces the largest amount of tobacco in the country. The average annual rainfall of KADD is about 900 mm (Table 7). Average annual rainfall amount ranged from 711 mm to 1140 mm during dry and wet years, respectively, from 1977 to 1987. The KADD is located in the central plain of the country. Average daily

**Table 7. Average amount of precipitation collected from 15 rainfall stations in KADD. Average values were computed from data collected for ten years, from 1977 to 1987.**

| RDPs | Rainfall station | Amount of rainfall (mm) | Range (Max-Min (mm)) |
|---|---|---|---|
| Dowa West | Mponela | 1981.67 | 1002.0-969.0 |
| | Madisi | 792.41 | 1051.0-637.9 |
| | Dowa agricultural station | 915.74 | 1126.1-743.0 |
| | Nambuma | 902.41 | 1056.9-795.6 |
| | Chisepo | 1033.59 | 1230.7-836.1 |
| | Bowe ADMARC[1] | 711.37 | 1065.3-518.7 |
| Dowa East | Dzeleka | 726.41 | 1005.1-321.4 |
| | Dowa forest | 858.94 | 1126.4-347.7 |
| | Mvera agricultural station | 953.05 | 1168.5-725.3 |
| Kasungu | K.F.C.T.A.[2] | 815.70 | 1176.4-714.5 |
| | Kochirira | 1139.98 | 1245.2-600.4 |
| | Kasungu aerodrome | 805.65 | 1086.5-630.0 |
| Mchinji | Tembwe | 972.70 | 1279.3-744.3 |
| | Likasi livestock center | 1020.00 | 1238.4-848.5 |
| Ntchisi | Malomo | 917.00 | 1155.7-652.0 |

[1]Agricultural development and marketing division
[2]Kasungu flue cured tobacco association

temperatures range from 12 to 28 degrees centigrade. Livestock numbers differ from one RDP to another (Table 6). Several methods were used in data collection, and in estimating carrying capacity and stocking rate.

**Data Collection**

Data were collected by use of a survey. The most commonly used methods of data collection in sample surveys are personal and telephone interviews. These methods, with appropriately trained interviewers and carefully planned callbacks, commonly achieve response rates of 60 to 75% or even higher (Scheaffer et al. 1994).

Personal interviews were conducted by KADD extension staff. The interviewer asked prepared questions and recorded the respondent's answers. The primary advantage of this method is that people will usually answer when confronted in person. In addition, the interviewer can note specific reactions and eliminate misunderstandings about questions asked. The major limitations of the personal interviews are high cost, errors in recording the responses, and interviewer deviations from the required protocol, each introducing a bias into the sample data

(Scheaffer et al. 1994). Any movement, facial expression, or statement by the interviewer can affect the response obtained. This was the only feasible method because the households do not have phones.

Direct observation was also used in this survey. It is used in many surveys that do not involve measurements on people. Wildlife biologists, for instance, may count animals, animal tracks, eggs, or nests in order to estimate the size of animal population (Scheaffer et al. 1994). This approach may take more time but may yield large rewards in important surveys.

Errors in data collection are categorized into sampling and nonsampling errors (Scheaffer et al. 1994). Sampling errors come about because of estimation. Data collected in a sample survey does not give exact information about a population. It only estimates the true information about the population. Nonsampling errors may arise due to nonresponse, inaccurate response, and selection bias.

Initially, it was planned that the interviewers would be given special training before conducting the interviews.

Due to insufficient funds, however, there was no training. It was assumed that previous experience that extension staff had acquired in conducting different types of national surveys was sufficient to do a good job.

KADD was stratified by size of livestock population in order to insure conformity of the sample with the latest available estimates. Fourteen EPAs were randomly sampled from all RDPs for data collection. Data were collected from all sections in all EPAs sampled. In each EPA chosen, 25 households were selected at random. First, household names were listed and assigned numbers. Then, selection was done at random from assigned numbers. Interviews were conducted in a total of 450 households. Details of questionnaires administered are presented in Table 8. The highest number of questionnaires was administered to Dowa West RDP and the least to Ntchisi. However, the highest number of EPAs was sampled in Kasungu RDPs. The number of questionnaires in Kasungu RDP was not the highest because there was a high nonresponse in Chulu EPA.

Each household was administered a questionnaire (Appendix A) to determine average livestock herd size, sex,

**Table 8. Survey sample area by rural development projects and extension planning area.**

| RDP[1] | EPA[2] | Number of Questionnaires administered per EPA | Number of Questionnaires administered per RDP |
|---|---|---|---|
| Mchinji | Mikundi (EPA 3) | 50 | |
| | Chiotcha (EPA 4) | 18 | 88 |
| | Mlonyeni (EPA 5) | 30 | |
| Dowa West | Madisi I (EPA 1) | 48 | |
| | Madisi II (EPA 2) | 43 | 116 |
| | Nambuma (EPA 4) | 25 | |
| Dowa East | Mvera (EPA 8) | 38 | |
| | Nachisaka (EPA 6) | 39 | 77 |
| Kasungu | Chulu (EPA 1) | 9 | |
| | Kaluluma (EPA 2) | 34 | |
| | Chivala (EPA 3) | 36 | |
| | Chipala (EPA 4) | 30 | 109 |
| Ntchisi | Chipuka (EPA 1) | 29 | |
| | Chikwatula (EPA 3) | 31 | 60 |
| Total for Kasungu ADD | | | 450 |

[1] Rural development project
[2] Extension planning area

age, reproductive performance, purchases, losses, and sales of livestock. In addition, the respondents were asked to rank the relative importance of cattle, sheep, and goats with respect to each other. Households did not keep written records on latest and previous parturition dates of all breeding females, including births and abortions. Reproductive performance data can be derived from the records of the latest and previous parturitions of all breeding females (Abdulle 1990).

Analysis of variance (ANOVA) was used to test whether there were differences in number of animals and prices due to season, year, and market. Graphs were used to find the relationships between average price per kilogram and numbers of livestock sold per month, average price per kilogram per month, and number of animals sold per month during the growing season and after harvest. These were used to determine if farmers sold their livestock when prices were low.

**Estimating Carrying Capacity**

There are a number of methods used to estimate carrying capacity. They are generally categorized into

direct and indirect methods. Direct methods involve weighing forage biomass of sample units to make an inference over an entire pasture. They include weight-estimate methods and harvest methods (Pieper 1988). Indirect methods measure some variable that is closely related to herbage weight and relatively easy to measure. This variable is related to herbage weight by regression analysis in a calibration procedure. Both approaches pose problems that are associated with characteristics of the African environment and the production systems found in the various ecological zones (De Leeuw and Tothill 1993). These problems relate to scale, species mix, mobility, land tenure, and production goals of the actual producers. The concept of carrying capacity assumes that livestock are kept within fixed areas of land with recognized boundaries. Such conditions do not exist in Malawi. Communal land tenure and fluid rights of access to grazing and water do not facilitate the computation of meaningful carrying capacity. In most of Southern Africa, stock-owning farmers have stable usufructuary rights to the land they cultivate, while

communal grazing lands are shared with many owners (De Leeuw and Tothill 1993). This implies that aggregate carrying capacity must be estimated for the entire area. In addition, multi-species exploitation of rangelands is common in Malawi. De Leeuw and Tothill (1993) warned that limitations of such data should be fully recognized in general forward projections in the light of sharp fluctuations over space and time. However, it must be recognized that feed resources are governed by an interlinked set of environmental factors. On most rangelands, precipitation (and, hence, soil water) is one environmental factor controlling herbage production (Pieper 1988). Consequently, precipitation has often been used as the independent variable to predict end-of-season herbage standing crop or biomass (Rogler and Haas 1947). In these studies, several years of data are necessary to develop reliable regression equations. It is important to have a wide range in precipitation values to develop a model with wide applicability.

There is a clear empirical relationship between large herbivore biomass and mean annual rainfall, which provides

a basis for first-order predictions of large herbivore biomass from meteorological data in the African savanna (Coe et al. 1976). The Coe et al. model positively correlated large herbivore biomass with mean annual precipitation using 20 widely dispersed eastern and southern African areas with less than 800 mm mean annual rainfall. Biomass on low nutrient status savanna soils tends to increase as annual rainfall increases from below 700 mm to more than 1000 mm (East 1984). Low nutrient areas, such as moist savanna woodlands of Malawi, are likely to support lower biomass per unit rainfall. Another weakness of the model is that it disregards the negative correlation between body size and energy requirements per body mass (Kreuter 1992). Kreuter (personal communication) did not use the Coe et al. equation because it was designed for East African areas that experience volcanic activities and are mostly alluvial. Instead, Kreuter correlated metabolic mass per hectare (MM = $W^{0.75}$ measured in kg $^{0.75}$ $ha^{-1}$ ) with mean annual rainfall (MAR in mm) using the following relationship with standard errors in parentheses.

$$MM = -2.47820 + 0.01965 * MAR$$

(1.68835) (0.00644)
(r=0.88; P<0.001; n=15)

where MM = metabolic mass per hectare and MAR = mean annual rainfall in millimeters.

This equation should predict the biological carrying capacity for a mixed, large herbivore community if long-term mean annual precipitation is used (East 1984). KADD receives an average of 903 mm of annual rainfall, there is no volcanic activity, and soils are mostly sandy clay loam. Therefore, the equation was used to predict biological carrying capacity. Sixteen rainfall stations were used to calculate the mean annual rainfall as detailed in Table 7. Rainfall values per station were based on 10-year averages.

Upland grazing sites were the principal areas used to estimate carrying capacity in this study. In communal areas, small "key resources" determine the ability of livestock to sustain themselves through the dry season and during the cropping season in a drought year (Scoones 1989). Key resources, which include wet dambos, patches of grasses, and crop residues, increase carrying capacity. Baars (1996) reported that grazing capacities of the wet

dambos were higher than woodland grazing capacities. This suggests that carrying capacity is underestimated using this equation. However, it will serve as a guide in estimating minimum carrying capacity. A potential carrying capacity of 1,034,000 tropical livestock units (TLUs) was estimated for western Zambia (Baars 1996). The Western Province of Zambia covers an area of about 12 million hectares and is mostly sandy. The area is unsuitable for crop agriculture. In contrast to the Western Province of Zambia, KADD is mostly sandy loam and suitable for arable agriculture. I would expect carrying capacity for KADD to be higher than the Western Province of Zambia. The FAO carrying capacity estimates for Malawi were not available for comparison. Grazing capacities of Zambian flood plains ranged from 0.1 TLU/ha on the higher plains to 2.5 TLU/ha in the channels (Baars 1996). Also, grazing capacities of lowland and woodland units ranged from 0.04 (dry Mopane pans) to 0.91 TLU/ha (wet dambos) and from 0.0 to 0.1 TLU/ha, respectively. I would expect grazing capacities for KADD to be higher than those of Western Zambia because KADD has sandy loam soils that are better than the sandy soils

of Western Zambia.

**Estimating Stocking Rate**

Stocking rate is the amount of land allocated to each animal unit for the entire grazing period of the year (Holecheck et al.1995). Since vigor of the herb layer of semiarid savannas is the primary determinant of productivity (Walker 1976), grazing pressure is of greater significance than total stocking rate when estimating herbivory impacts on rangeland productivity. Herbivory pressure is a function of herbivore community structure and the population size of each herbivore species (Kreuter 1992). Grazing pressure ($SR_{gp}$) is measured in livestock $kg^{0.75}$ $ha^{-1}$. I disregarded wildlife because there is only a negligible population that grazes on communal land. Kreuter (1992) used the following formula to derive stocking rate:

$$Sr_{gj} = A^{-1} \sum N_i * W_i^{0.75} * G_i$$

where j=species (cattle, sheep and goats), A = area of ranch (ha), $N_i$ = species i population size or number of cattle in age/sex category I, $W_i$ = unit body weight of

species i or cattle age/sex category i, and $G_i$ is the grass fraction in the diet of species i.

I used the formula to calculate stocking rate. However, A was used to stand for the area grazed and a tropical livestock unit (TLU) was 250 kg liveweight (Jahnke 1982). Stocking rate of the grazing fractions of herbivores ($SR_{gj}$ measured in $KG^{0.75}$ $ha^{-1}$) was estimated using a constant unit body mass (mean individual body mass of each species weighted for average herd structure) for five sex and age categories for cattle and sheep/goats as detailed in Table 9.

**Table 9. Biomass (kg), metabolic mass ($kg^{0.75}$), and proportion of grass fractions in the diets of herbivores.**

| Five sex and age categories of cattle and sheep/goats | Unit body mass | | Total number of animals | Grass composition in diet |
|---|---|---|---|---|
| | Biomass | Metabolic mass | | |
| Bulls | 600 | 121.2 | 26631 | 100 |
| Steers | 600 | 121.2 | 36142 | 100 |
| Cows | 400 | 89.4 | 68479 | 100 |
| Heifers(greater than one year) | 275 | 67.7 | 9946 | 100 |
| Weaners plus calves (less than six months) | 150 | 42.9 | 19022 | 100 |
| Sheep/goats | 35 | 14.4 | 233104 | 50 |

Source: Kreuter (1992, p. 96)

# RESULTS

Results are presented in seven parts: average herd and flock size; carrying capacity and stocking rate; relative importance and rationale for keeping different species of livestock; rationale for selling different age groups; sex and species of livestock; effects of marketing systems; and effects of "seasons" on livestock prices and effect of price on cattle numbers sold. The first four parts describe range livestock production while the last three describe marketing systems in KADD.

## Average Herd and Flock Sizes

Estimated cattle, sheep, and goat numbers in the KADD for 1995 are presented in Appendix A. The range livestock species found in largest number was chickens estimated at 569,000. Chickens were considered as range livestock because of the nature in which they are reared. They are left to free range in the bush during the day and expected to return to their dwelling units during the night. More than half of them were estimated in Dowa West RDP. The lowest estimated number was in Ntchisi RDP. Goats were the

second largest, followed by cattle and sheep, respectively. Kasungu RDP had the largest number of cattle. The second largest number was found in Dowa West RDP and lowest number in Dowa East (see Fig.4). Average cattle herd size per household was estimated at 0.76. Flock sizes for sheep and goats were estimated at 0.12 and 0.81, respectively. The sex structures of herds and flocks (the percentage of the total number of animals in each sex group) were derived from the herds and flocks sampled. The estimated percentages are presented in Fig. 5, 6, and 7. Breeding females formed the largest proportion of all species. Cows made up 36% of total cattle, followed by steers at 19%. A similar sex structure pattern was observed for sheep and goats (Fig. 6 and 7). For cattle, households retained cows for the longest time period, averaging 5.7 years. Steers and bulls were retained for 4.6 years and 4.0 years, respectively. The proportion of young animals less than 2 years for both females and males was low, especially for cattle. Only 35% of calves born survived. The major cause of loss was diseases (mainly East Coast Fever). Households kept a high proportion of breeding females to increase

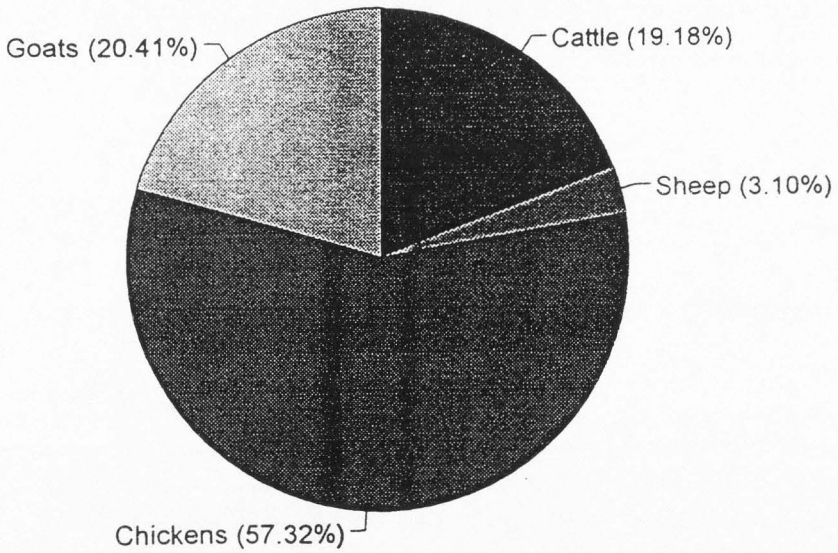



Fig.4. Livestock proportions in KADD, based on 1995 counts from a survey conducted in KADD. Grand total livestock populations were 190,220 cattle, 30, 705 sheep, and 202,399 goats.

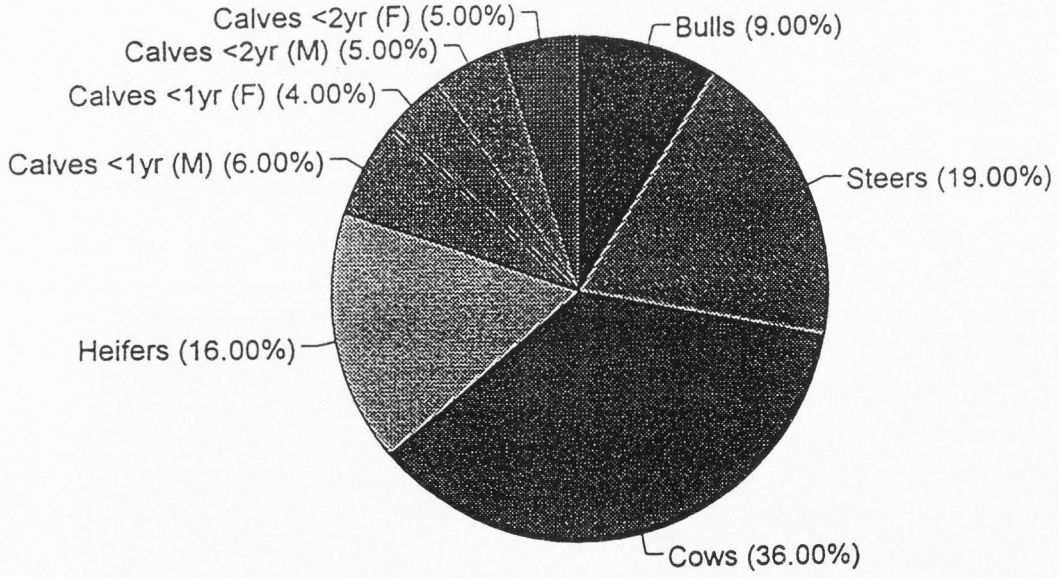



**Fig. 5. 1995 estimated cattle herd structure for KADD. Total cattle population was estimated at 190,220.**

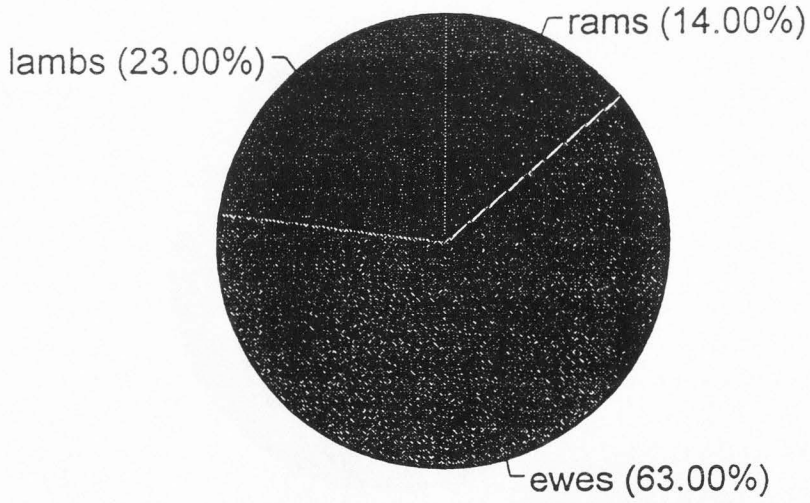



Fig. 6. 1995 estimated sheep flock structure for KADD. Total sheep population was estimated at 30,705.

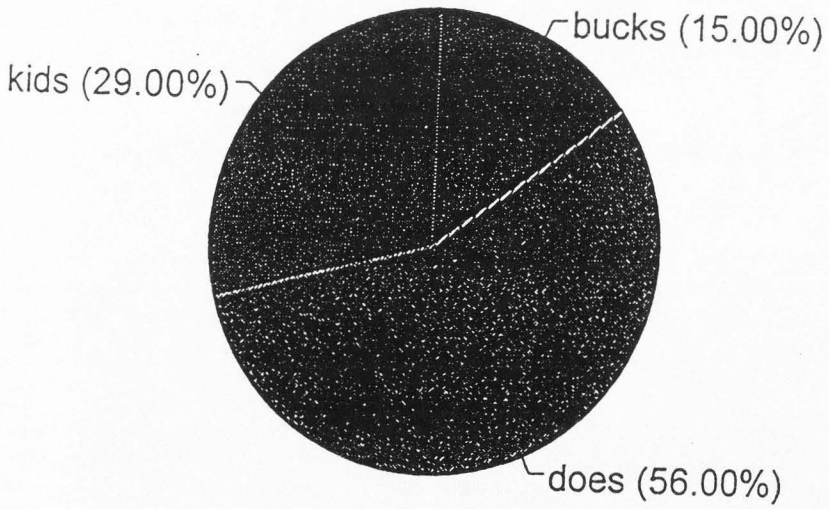



Fig. 7. 1995 estimated goat flock structure for KADD. Total goat population was estimated at 202,399.

livestock numbers (Appendix A). Eighty-five percent of households would like their livestock numbers to increase. Although households would like to keep more livestock, grazing land is being reduced. In addition, there is no information about carrying capacity and stocking rate in KADD. In order to match livestock numbers and available feed and determine whether or not grazing land was overstocked and hence overgrazed, carrying capacity and stocking rate were estimated.

**Carrying Capacity and Stocking Rate**

The estimated carrying capacity and stocking rate were 15.27 kg metabolic mass per hectare and 11.95 kg metabolic mass per hectare, respectively. Carrying capacity was higher than stocking rate, suggesting that the current livestock numbers can be sustained on the available grazing land. Therefore, we reject the hypothesis that stocking rate will exceed carrying capacity. Stocking rate will not always be higher than carrying capacity. However, caution must be taken concerning the results because the formula used works best when rainfall is about 800 mm, which is less than average rainfall for KADD. The responses of

households as to the question of whether they want to increase their livestock numbers are presented in Appendix A. Eighty-five percent of households desired to increase their livestock numbers, possibly due to the availability of perceived unused grazing land.

**Relative Importance and Rationale for Keeping Each Livestock Species**

Sixty-two percent of households ranked cattle as the most important livestock species; therefore, we reject the hypotheses that goats would be favored. Only about 20% ranked goats as most important and 18% ranked poultry first (see Appendix A). Cattle were considered the most important because of their contribution to livelihood of the households. They provide income, draft power, milk, manure, and meat. A small number of households indicated that one commands more respect if he has a larger herd than others. However, goats and chickens were said to be important because they are easy to keep since grazing land needed to raise them is small. They are also easy to slaughter. Cattle require a permit from government veterinary assistants to slaughter, while goats and chickens can be

slaughtered at home without any consultation with any government official. In addition, households do not have problems of storage after slaughter of goats and chickens because of their convenient size, unlike cattle, which require a freezer.

**Rationale for Selling Livestock**

Percentages of households selling their livestock at various seasons and markets are presented in Appendix A. As shown there, an estimated 63% of households sold their cattle during the wet season. All households sold their animals at this time of the year to meet immediate cash demands. Therefore, we reject the hypothesis that farmers supply animals to market primarily in response to price. About 46% sold their livestock at produce markets. According to the results in Appendix A, advantages of selling livestock at produce markets included: selling at any time without following a schedule and availability of produce markets at short distance, thus avoiding the labor for trekking animals to the auction markets, which are often far away. Households may also sell at produce markets because that may be the only available market. The

disadvantages respondents listed included: having to sell small parts of a carcass at a time, having to share meat with relatives, and being forced to sell the meat at reduced price because of storage problems. This was common in the rural areas. The remaining 54% sold their cattle at auction markets. The respondents listed the following advantages: receiving higher prices than at produce markets, the opportunity to sell the whole animal, and receiving the full price at one time. Liveweight market was a general term that included the government-structured auction markets as well as sales at homesteads. Some butchers buy the animals at the homestead to take advantage of the households' desperate need for cash. More than half of auction market sales occur at their homesteads and the buyers are butchers. Lower prices are generally offered at such purchases. However, there was no separate information on purchases at homestead to analyze their effects on prices. There was a significant difference between number of animals sold at auction and produce markets and between sales after harvest and sales during the growing season ($P<.001$, Table 10). However, 90% of the households stated

**Table 10. ANOVA of the effect of years, seasons, and markets on number of animals sold using the General Linear Models procedures in SAS. There were three years, 1991, 1992, and 1993; two seasons, wet and dry; and two market systems, produce and auction markets**

| Source | DF | Sum of Squares | Mean Squares | F Value | Pr >F |
|---|---|---|---|---|---|
| Model | 11 | 7650841.0417 | 695531.0038 | 56.87 | 0.0001 |
| Error | 60 | 733795.8333 | 12229.9306 | | |
| Corrected Total | 71 | 8384636.8750 | | | |

| R-Square | C.V. | Root MSE | Count Mean |
|---|---|---|---|
| 0.912483 | 24.50500 | 110.58902 | 451.29167 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Year | 2 | 123383.5833 | 61691.7917 | 5.04 | 0.0094 |
| Season | 1 | 193131.1250 | 193131.1250 | 15.79 | 0.0002 |
| Year*Season | 2 | 16588.0833 | 8294.0417 | 0.68 | 0.5114 |
| Market | 1 | 7046883.6806 | 7046883.6806 | 576.20 | 0.0001 |
| Year*Market | 2 | 202505.3611 | 202505.3611 | 8.28 | 0.0007 |
| Season*Market | 1 | 1467.0139 | 1467.0139 | 0.12 | 0.7303 |
| Year*Season*Market | 2 | 66882.1944 | 66882.1944 | 2.73 | 0.0730 |

that they preferred selling at auction rather than at produce markets because of better returns. Although 79% of the total households sampled were aware of the time of year when prices were highest in both markets, part of them sold at produce markets. Male cattle over 5 years of age were preferred for sale because they were not needed for breeding, and were heavier than females, hence fetching more money at the market. Males not used for draft power were also sold along with nonproductive cows.

**Effects of Marketing Systems**

The effects of marketing systems on prices and number of animals sold are presented in Figures 8, 9, and 10. Average prices at auction markets were higher than at produce markets throughout the year except in March. In 1991 and 1992, the prices at auction markets were higher than produce markets throughout the year. However, in 1993 the auction market price was lower than the produce market price in February, March, and October. In general, prices at auction markets were higher than at produce markets regardless of supply, livestock species, and season. The prices at produce markets were determined at the beginning

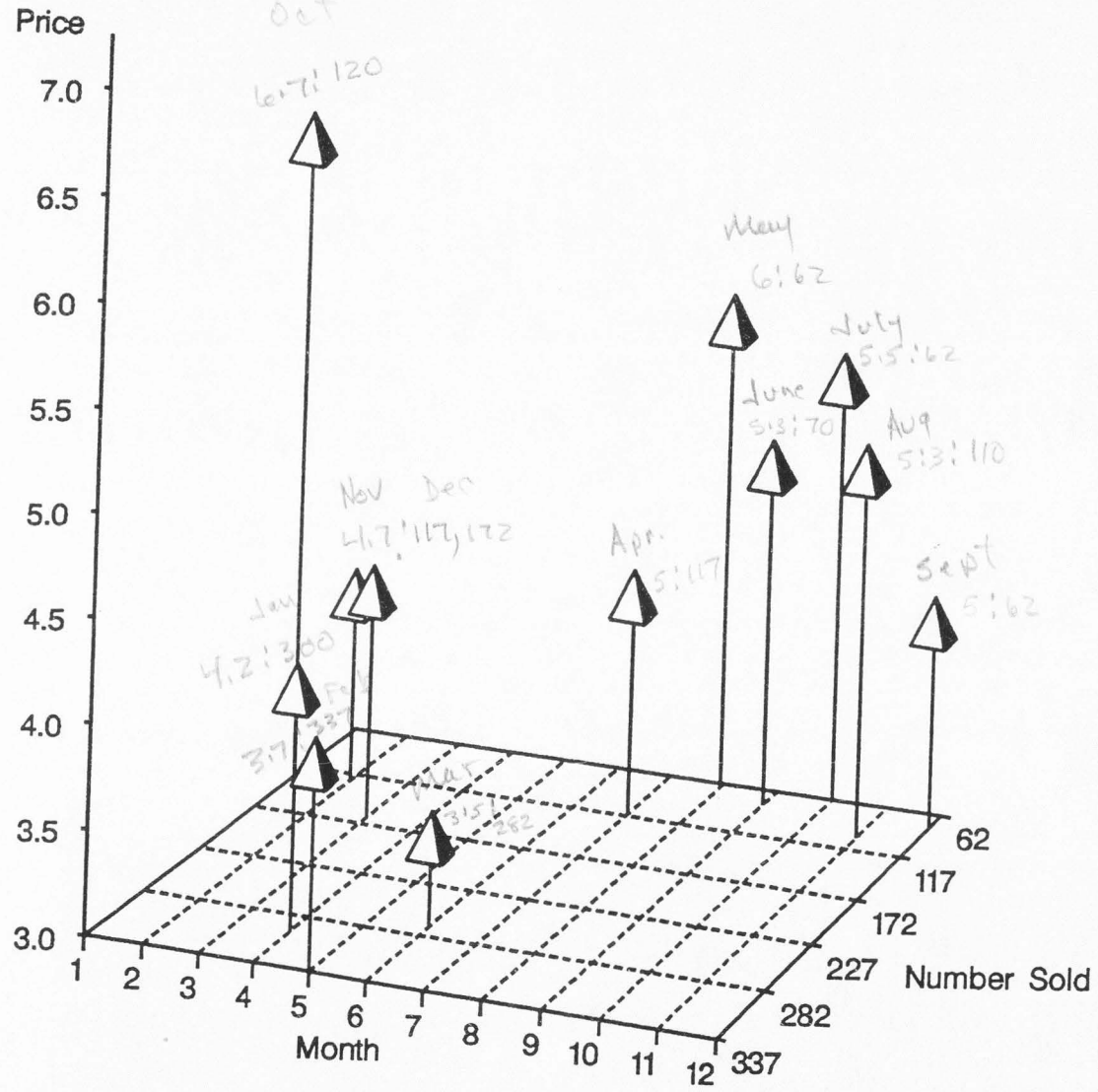



Fig. 8. Auction market prices for 1991 by month and number of animals sold. Months are numbered from October = 1 to September = 12.

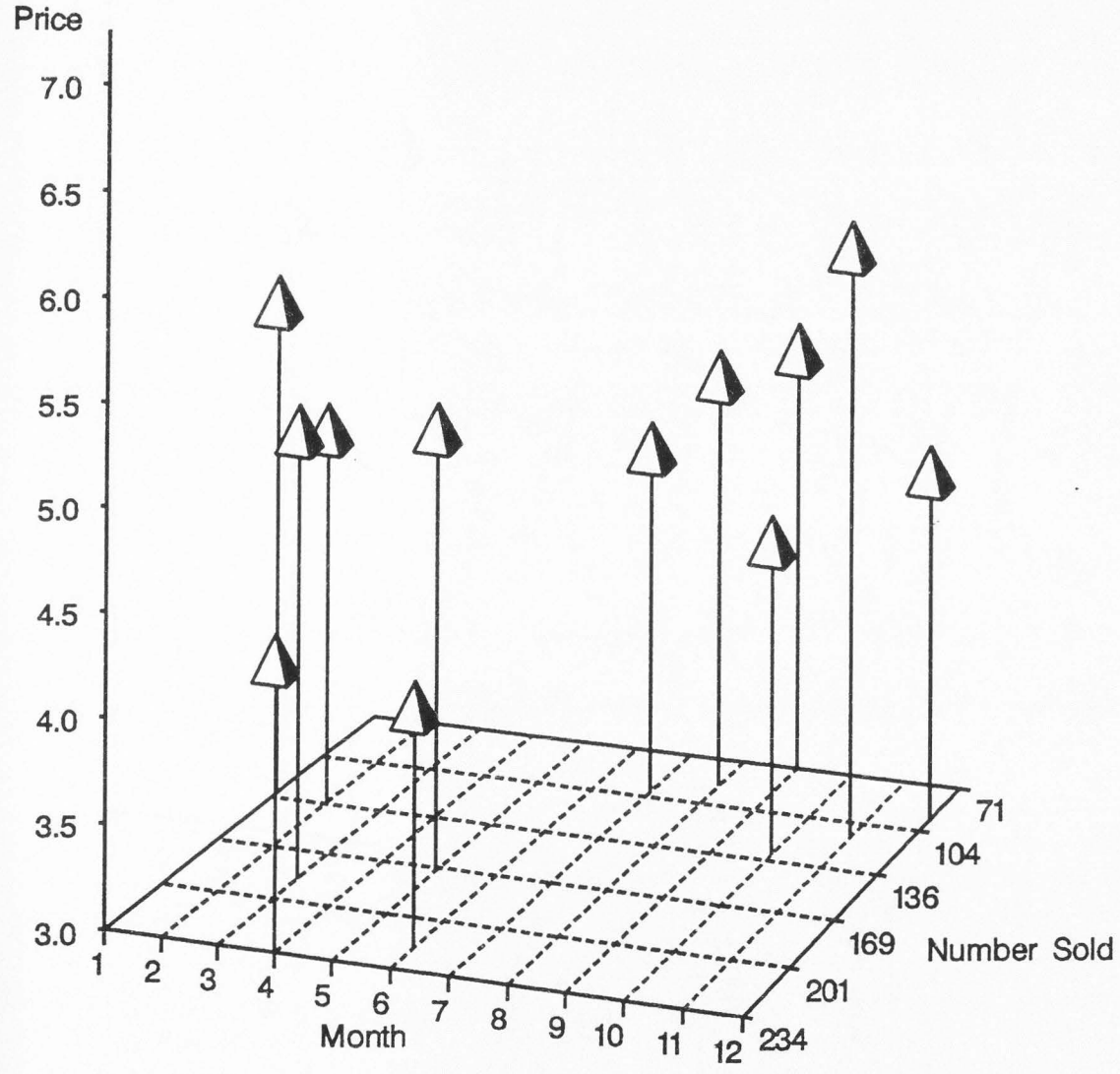



Fig. 9. Auction market prices for 1992 by month and number of animals sold. Months are numbered from October = 1 to September = 12.

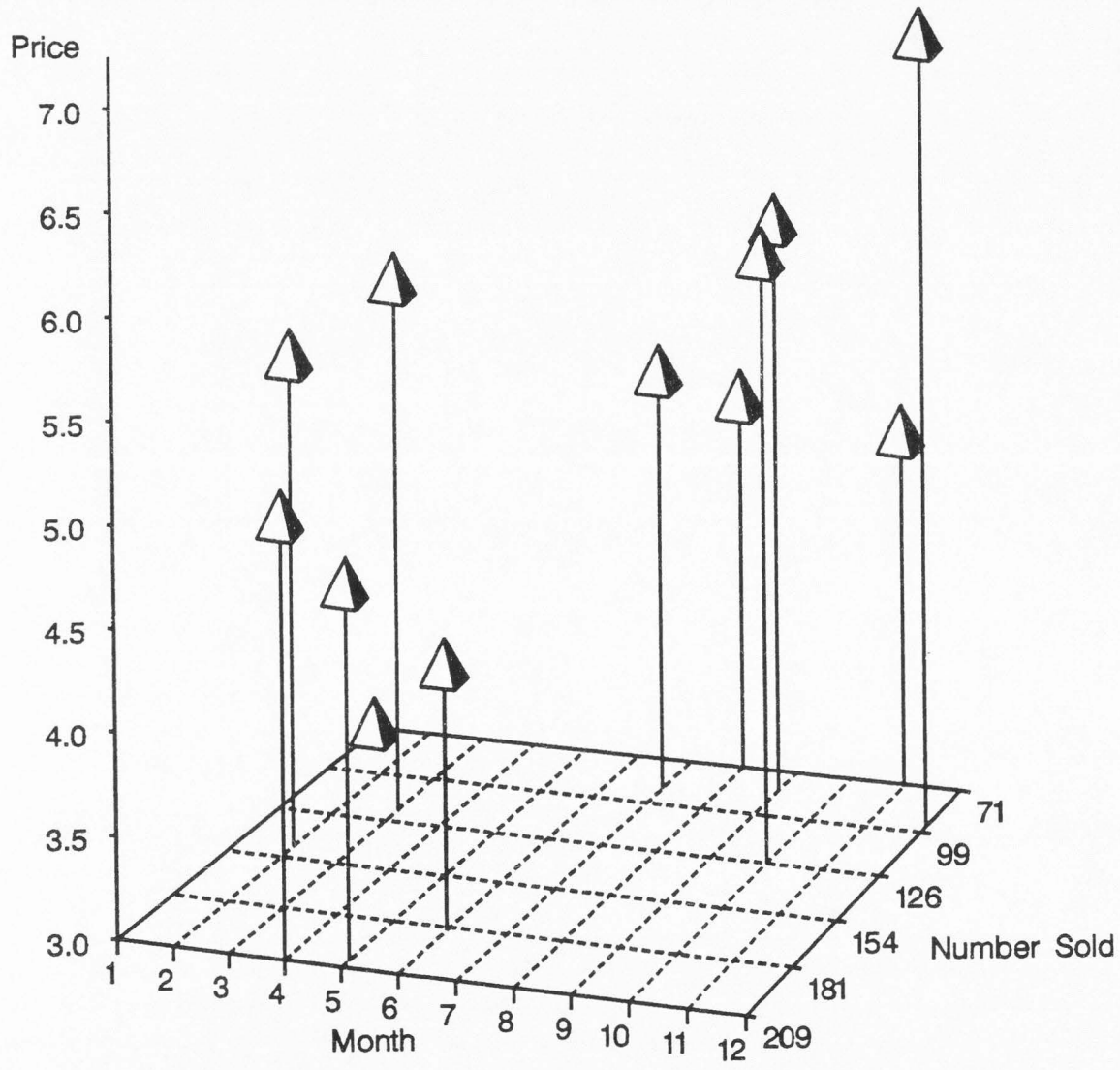



Fig. 10. Auction market prices for 1993 by month and number of animals sold. Months are numbered from October = 1 to September = 12.

of the year and remained constant throughout the year while the prices at auction markets were determined by demand and supply. Although there was a significant difference between number of animals sold at produce and auction markets ($P<.001$, Table 10), there was a significant interaction between year and market ($P<.0015$, Figure 11). Interaction came about because in 1993, the number of animals sold at produce markets increased significantly as a result of an increased produce market price from MK2.50 to MK5.00 per kg (Appendix B, Table 12). There was no significant difference between prices in different seasons ($P<.0.05$, Table 11).

**Effects of Price on Cattle Numbers Sold**

The effects of price on cattle numbers sold at auction markets are presented in Figure 12. Cattle numbers sold at produce markets were not affected by price per kilogram because it was constant throughout the year. However, the price per kilogram at auction markets changed throughout the year; hence, Figure 12 shows effects of price on cattle numbers sold at auction markets only. Fewer than 110 cattle were supplied at the market when the average auction price

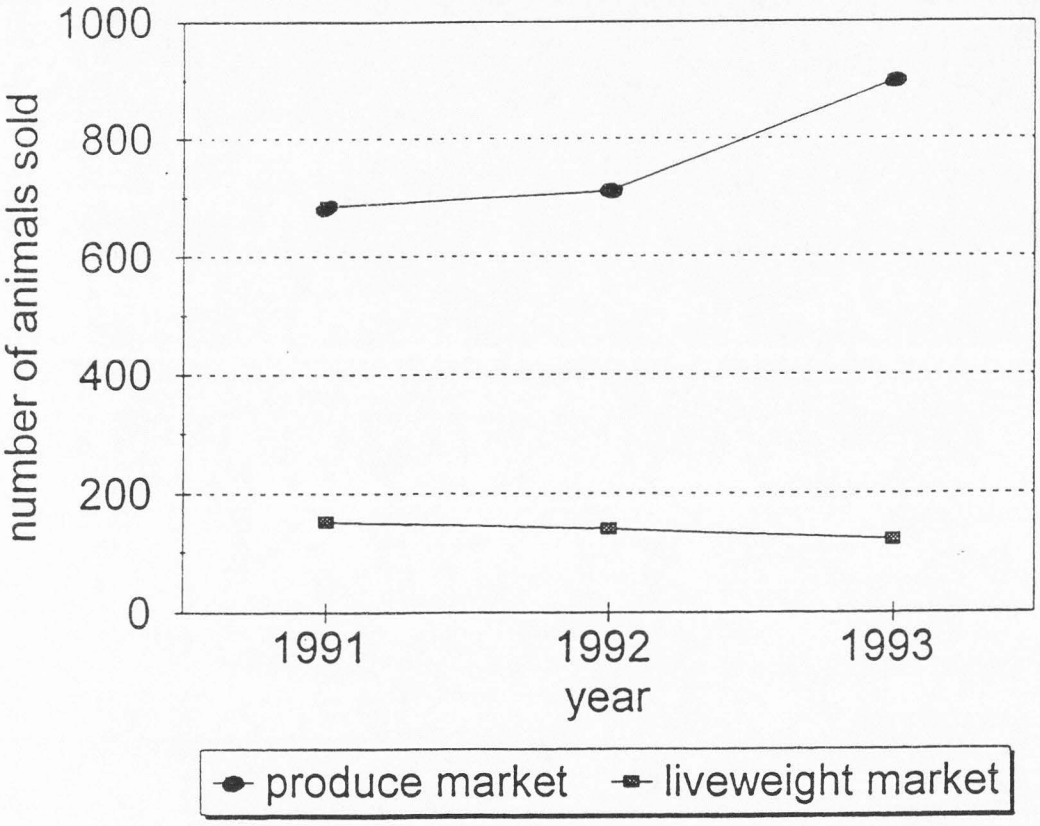



Fig. 11. Year and market interaction ($P<.001$). The difference between number of animals sold at auction markets (solid ovals) and at produce markets (solid rectangles) in 1991 and 1992 was not significantly different, while in 1993 the difference was significantly different from that for 1991 and 1992.

**Table 11. ANOVA of the effect of years, seasons, and markets on price per kilogram livestock using the General Linear Models procedure in SAS. Data was collected for three years from wet and dry seasons. The two markets were produce and auction markets.**

| Source | DF | Sum of Squares | Mean Squares | F Value | Pr >F |
|---|---|---|---|---|---|
| Model | 13 | 136.2416 | 10.4801 | 4.95 | 0.0001 |
| Error | 58 | 122.8527 | 2.1181 | | |
| Corrected Total | 71 | 259.0943 | | | |

| R-Square | C.V. | Root MSE | Count Mean |
|---|---|---|---|
| 0.5258 | 32.7485 | 1.4554 | 4.4442 |

| Source | DF | Type III SS | Mean Square | F Value | Pr>F |
|---|---|---|---|---|---|
| Year | 2 | 133.7345 | 66.8673 | 31.57 | 0.0001 |
| Month | 11 | 2.5071 | 0.2279 | 0.11 | 0.9998 |
| Contrast | DF | Contrast SS | Mean Square | F Value | Pr>F |
| Wet vs Dry | 1 | 0.3640 | 0.3640 | 0.17 | 0.6800 |
| 3 vs 4 | 1 | 0.5324 | 0.5324 | 0.25 | 0.6180 |

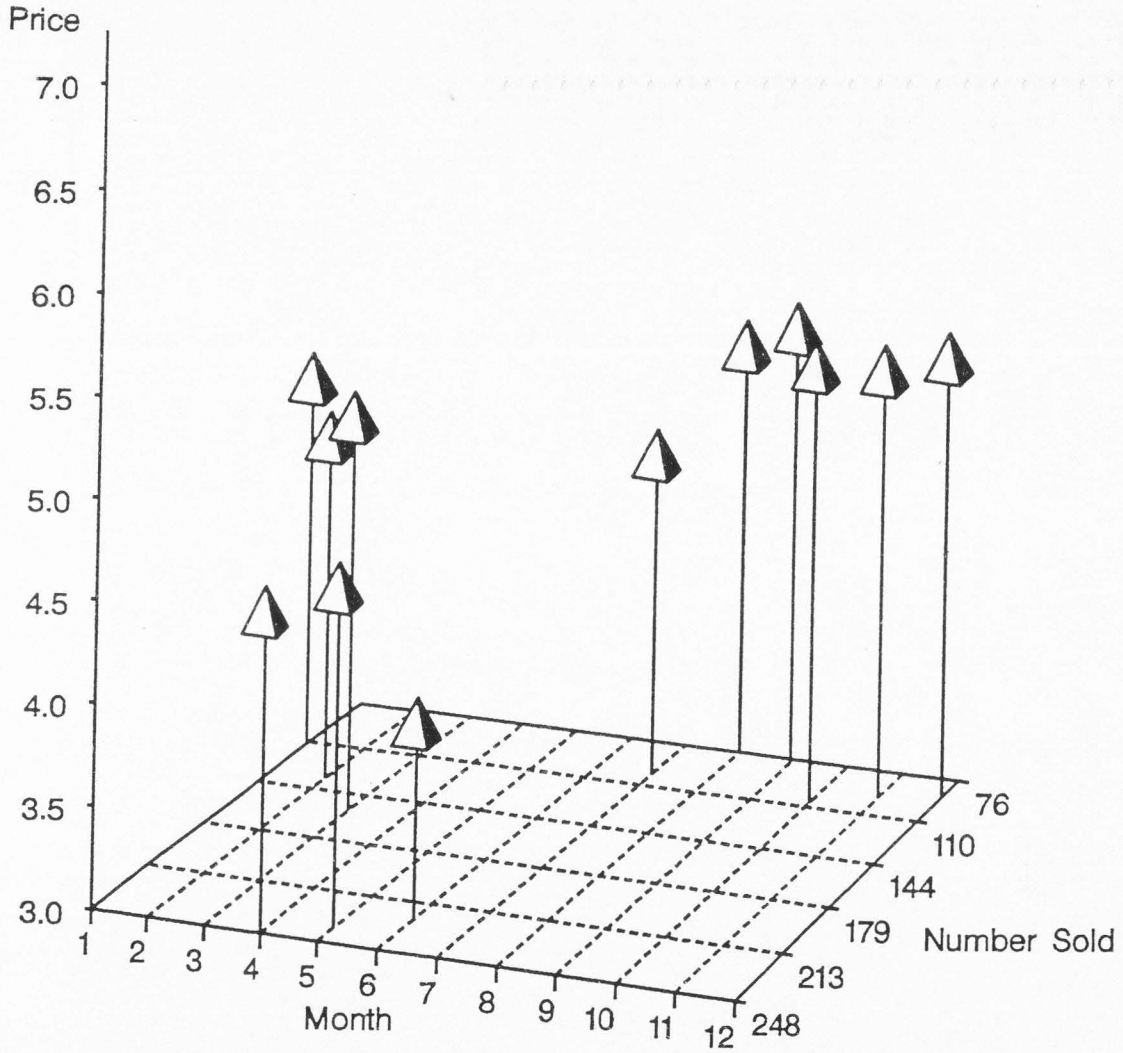



Fig. 2. Average auction market price for 1991-1993 by month and average number of animals sold. Months are numbered from October =1 to September = 12.

per kilogram was above MK 5.2, and more than 110 cattle were supplied when the prices were less than MK 4.9. More than 213 cattle were sold when the price per kilogram was at the lowest. In general, households supplied fewer cattle at the market when the prices were high and more when the prices were low. However, as noted in Figure 11, more cattle were sold at produce market in 1993 than in 1992 because of increased produce prices relative to auction market prices. This shows that households respond positively to increased prices but sell only when it is convenient.

**Effects of Season on Price and Number of Animals Sold**

The effects of season on prices per kilogram of cattle and number of cattle sold are presented in Tables 10 and 11. There was no interaction between season and year nor between season and market ($P>.500$). Season had a significant effect on number of cattle sold ($P<.001$). There was no significant difference between price per kilogram of cattle during wet and dry season ($P=0.68$, Table 11). The price of cattle at auction markets increased after

harvest from March to September and decreased during the growing season. However, more cattle were sold during the growing season than after harvest. The highest numbers were sold from November to March and the lowest number of cattle were sold in June (see Figure 12).

## CONCLUSIONS

The results show that stocking rate was lower than carrying capacity, implying that farmers can increase their livestock numbers. Although households desired to increase livestock numbers, they were aware that grazing land is being reduced in size. More land was opened for settlement due to increased human population and privatization. As noted before, farmers a practice communal grazing system. Evangelou (1984) pointed out that in communal grazing, overstocking results because an individual owner reaps the full benefit of additional animals, while costs in pasture, water, and eventual range degradation due to overgrazing are shared by all households. This may be an incentive to increase livestock numbers. Before any conclusions can be drawn on stocking rate, there is a need to conduct a similar study to estimate carrying capacity using direct methods. If the results will be the same, households will be encouraged to increase their livestock numbers. If stocking rate will be found to be greater than carrying capacity, then households will be encouraged to keep

animals that do not require land for their survival, like rabbits, chickens, and guinea pigs.

Households in KADD consider cattle as the most important ruminant livestock. Cattle contribute more than goats and any other ruminant livestock, particularly on nonterminal befits. They provide milk, manure, and draft power. In addition, they are kept as "moving banks." When households do not have immediate need for cash, wealth is stored in the form of cattle for future generations. The herd structures of all livestock species reflect the importance of breeding females and relative high rates of disposal of males through sale and slaughter.

Female livestock were kept for breeding and milk production. From results in Appendix A, milk was consumed locally and surplus was sold. However, a high proportion of cows over 4 years of age, given the low proportion of immature replacement heifers, suggests that some old and nonreproducing cows must have been retained. More breeding females and fewer males may have resulted from the government policy to increase livestock numbers by discouraging the sale of productive animals. Farmers may

not be open to disclose the details of their sales in terms of whether the cattle were productive, young, or old. The policy was adopted because of small average herd and flock sizes.

Households listed steers as the second most important group. They indicated that steers were used for draft power and therefore hired out to obtain cash. Since they are mostly crop farmers, steers were said to be used for ploughing and transporting farm produce and inputs from the farm to the market and from the market to the farm, respectively. In addition, households mentioned that livestock played an important role in ceremonial activities like weddings and celebrations. During weddings, Christmas, and Independence Day celebrations, livestock are slaughtered for consumption. From the results, there is evidence that households value livestock more for their intermediate benefits like milk and draft power than for terminal benefits like meat and cash.

Results show that more animals were sold during the rainy season and fewer during the dry season. However, the prices per kilogram were low during the rainy season and

higher during the dry season. During the wet season, households need cash to buy food and farm inputs and pay for school fees. Survey results in Appendix A are interpreted to show that households sold cattle to meet immediate cash needs like buying fertilizer and food, and paying for medical bills and school fees. Food purchase was the most important reason for selling their livestock. Most farm families run out of food by the end of the year, necessitating livestock sales during the growing season. Throughout the growing season, more livestock sales occur until after harvest in March. After harvest, households have sufficient food and cash from crop harvests; hence there is less need to sell livestock. The relationships between number of livestock sold and price and between number of livestock sold and season are just a manifestation of the household need to purchase food. In order for households to produce more food, fertilizer was used, increasing the demand for cash and hence more livestock sales. The need for cash for paying medical bills exists both during the growing season and after harvest. However, the only available sources of income are selling

their cheap labor and livestock. This explains why more animals were supplied at the market for sale during the rainy season. Buyers take advantage of this desperate situation and therefore pay low prices for the animals bought. In conclusion, households sell their livestock to solve their immediate cashflow problems; price is only a secondary factor.

Prices at auction markets were higher than at produce markets throughout the year for 1991 and 1992 but this was not the case for 1993. However, more animals were sold at produce markets in all the years, throughout the seasons. This is because auction markets sales follow a schedule and often are located at long distances while produce markets are always operating and are located nearby. From the survey results, half of the households chose auction markets and the other half chose produce markets. This means there is no preference on the market systems.

Households were aware that auction markets offer better returns than produce markets and that higher prices were offered during the dry season than during the growing season. However, most of them still sold their livestock at

produce markets and more animals sold during the growing season. High livestock sales thus coincide with seasons in which cash flow problems are paramount and price is only a secondary factor. About 51% of households indicated that they would reduce the sale of livestock if the price increased while prices of other goods and services remain constant because fewer livestock sale would then provide sufficient cash.

In summary, more animals were sold during the rainy season when the prices were low than during the dry season when the prices were high. The main reason for selling the animals was to solve immediate cash problems. In addition, a higher price was offered at auction markets than at produce markets. I recommend farmers sell their animals at auction markets in places where they are available. Although the prices during the rainy season were different from prices during the dry season, in absolute terms they were not statistically significantly different. I therefore recommend similar research to be conducted to compare the results. If the prices had been statistically different, then I would have recommended that farmers sell their

animals during the dry season.

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# APPENDICES

# Appendix A
# Survey Questionnaire and Summary of Responses

Survey Questionnaire

1. Confidential

2. Household #.....Todays's date  Month  Year

3. EPA

1. HERD SIZE DATA

i. How many animals do you have?
Cattle..... Sheep.... Goats..... Chickens.....

a) Cattle
Bulls..... Steers.....Cows.....Heifers.....
Calves: Less than 1 year
Bull calves..... Female calves.....
Less than 2 years
Bull calves..... Female calves.....
Ages of bull(s).....
Steers.....
Cows.....

b) Sheep
number of rams.....
number of ewes.....
number of lambs.....

C) Goats
number of bucks.....
number of does.....
number of kids.....

ii. Do you want to keep larger herd than you have now?
Yes.....  No.....

Explain your answer

.....
.....
.....
.....

iii. Who controls the grazing land?

Chief..... Private.....

If land is contrilled by chief, do you graze on land which is only under your chief?

Yes..... No.....

iv. Do you have rules governing the use of land?

Yes..... No.....

v. Who enforces the rules

.....
.....

vi. Do you have any problem with grazing land?

Yes..... No.....

vii. If grazing land is getting smaller, what is the cause?

.....
.....
.....
.....

Viii. If the number of livestock increases to the point where they cannot be maintained because of insufficient feed, how do you think your animals are going to survive?

.....
.....
.....
.....

Rank the livestock according to their importance

1.....
2.....
3.....
4.....

Why?

.....

5 REPRODUCTIVE DATA

i. How many breeding cows do you have?.....

ii. When was the last year and month your cows dropped (gave birth to a calf) a calf (include abortions)

| cow # | Year /month |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| . | |
| . | |

iii. How many calves were born for the past 5 years?.....

iv. How many calves survived?.....

v. How many died, because of
diseases..... what was the major disease.....
predation..... (name the predator).....
theft.....

6. MARKETING DATA

i. How many animals did you sell this year?.....
Less than 5 years ago.....
more than 5 years ago.....

ii. In which market(s) did you sell the animals?
produce ..... live weight.....
why?

.....
.....

iii. Which market do you prefer?
produce..... live weight.....

why?

.....
.....

iv. Do you know which market offers the highest price?

Yes..... No.....

v. Did you chose the market because of prices?

Yes..... No.....

If not, what influenced you to sell to the market chosen in question ii.

.....
.....
.....
.....

vi. What time of the year did you sell your animal(s)

Jan - Feb...March - May...Jun - Aug...Sept. - Dec...

why?

.....
.....
.....

vii. Do you know the time when the prices are high in all markets?

Yes..... No.....

viii. If the price of livestock increases while the prices of other products, fees, medical charges remain the same, are you going to increase or decrease sales of animals?

Increase..... Decrease.....

why?

.....
.....
.....

ix. Were you influenced by season to sell the cattle this year?

Yes..... No.....

x. If not, what influenced you to sell the cattle this time

(season-rainy season, dry season) of the year?

.....
.....
.....
.....

xi. What sex of cattle is preferred for sale?

Male..... Female.....

Why?

.....
.....
.....

xii. What age group do you sell (tick)

2 years
3 years
4 years
>5 years

Why?

.....
.....
.....

xiii. Do you sell the animals only to meet a specific problem?

Yes..... No.....

If not, why do you sell the animal?

.....
.....
.....

xiv. Which type of livestock (cattle, sheep, goats) do you prefer to sell - chose one

.....
.....

xv. Which is more important, livestock or crops?

Explain your answer

.....
.....
.....
.....

Summary of Responses

## 1. Estimated 1995 livestock census figures

| | Dowa West | Dowa East | Kasungu | RDP Mchinji | Ntchisi | Total |
|---|---|---|---|---|---|---|
| Cattle | 57,487 | 13,485 | 61,344 | 38,910 | 18,994 | 190,220 |
| Sheep | 14,930 | 303 | 5,622 | 1,179 | 8,671 | 30,705 |
| Goats | 112,215 | 36,293 | 4,481 | 24,687 | 24,723 | 202,399 |
| Chickens | 342,870 | 72,819 | 63,990 | 51,291 | 37,533 | 568,503 |

## 2. Herd and Flock Structure

a) CATTLE

I) Herd Structure (Expressed as a percent)

| | | | | | | |
|---|---|---|---|---|---|---|
| Bulls | 6 | 9 | 9 | 10 | 14 | 9 |
| Steers | 18 | 10 | 18 | 20 | 15 | 19 |
| Cows | 35 | 31 | 37 | 38 | 33 | 36 |
| Heifers | 21 | 25 | 15 | 10 | 17 | 16 |

calves: Less than 1 year

| | | | | | | |
|---|---|---|---|---|---|---|
| Male calves | 8 | 1 | 5 | 7 | 5 | 6 |
| Female calves | 6 | 0 | 6 | 6 | 3 | 4 |

Calves: less than 2 years

| | | | | | | |
|---|---|---|---|---|---|---|
| Bull calves | 4 | 5 | 5 | 6 | 3 | 5 |
| Female calves | 2 | 9 | 5 | 3 | 10 | 5 |

II) Average age (Years)

| | | | | | | |
|---|---|---|---|---|---|---|
| BullS | 2.50 | 3.98 | 5.12 | 3.80 | 3.80 | 3.95 |
| Steers | 2.76 | 4.76 | 5.19 | 5.00 | 4.80 | 4.58 |
| Cows | 3.95 | 5.97 | 6.24 | 5.83 | 6.90 | 5.71 |

b) SHEEP

I) Flock Structure (Expressed as a percent)

| | | | | | | |
|---|---|---|---|---|---|---|
| Rams | 13 | 13 | 16 | 13 | 19 | 14 |
| Ewes | 69 | 75 | 56 | 60 | 67 | 63 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Lambs | 17 | 12 | 28 | 27 | 14 | 23 |

c) GOAT

I) Flock Structure (Expressed as a percent)

| | | | | | | |
|---|---|---|---|---|---|---|
| Bucks | 14 | 10 | 17 | 17 | 16 | 15 |
| Does | 66 | 57 | 52 | 54 | 56 | 56 |
| Kids | 20 | 33 | 30 | 29 | 28 | 29 |

**3. Summary of survey results (Expressed as a percent)**

| | | DW | DE | KU | MCH | NTCH | AVERAGE | REASONS |
|---|---|---|---|---|---|---|---|---|
| Do you want to keep larger herd than you have now? | -Yes | 92 | 76 | 82 | 99 | 63 | 86 | -help in need/ security<br>-more food/manure draft power 250/300<br>-more animals means providing reasons. |
| | -No | 8 | 24 | 18 | 1 | 37 | 14 | -increase in theft (6/11 providing reasons)<br>-reduced grazing land (4/11 providing reasons) |
| Who controls the grazing land? | -Chief | 99 | 84 | 89 | 67 | 100 | 85 | |
| | -Private | 1 | 26 | 11 | 33 | 0 | 15 | |
| If land is controlled by chief, do you graze on land which is only under your chief? | -Yes | 82 | 39 | 41 | 40 | 39 | 48 | |
| | -No | 8 | 61 | 59 | 60 | 61 | 52 | |
| Do you have rules governing the use of land? | -Yes | 87 | 66 | 50 | 85 | 94 | 74 | |
| | -No | 13 | 34 | 50 | 15 | 6 | 26 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Who enforces the rules? | -Chief | 97 | 78 | NA | 62 | 98 | 79 |
| | -Private | 0 | 2 | NA | 7 | 0 | 3 |
| | -Government | 3 | 20 | NA | 31 | 2 | 18 |
| Do you have any problems with grazing land? | -Yes | 81 | 73 | 51 | 44 | 85 | 61 |
| | -No | 19 | 27 | 49 | 56 | 15 | 39 |
| If the grazing land is getting smaller, What is the cause? | -increase in human population | 95 | 63 | 68 | 93 | 99 | 83 |
| | -increase in privatization | 5 | 17 | 26 | 7 | 0 | 13 |
| | -Increase in animal population | 0 | 0 | 6 | 0 | 1 | 2 |
| | -Land degradation and others | 0 | 20 | 0 | 0 | 0 | 2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| If the number of livestock increases to the point where they cannot be maintained because of insufficient feed, how do you think your animals are going to survive? | -Use supplementary feeds | 78 | 30 | 50 | 45 | 47 | 51 |
| | -Sell extra | 20 | 70 | 46 | 29 | 44 | 38 |
| | -Settle new with plenty of feeds | 2 | 0 | 0 | 4 | 0 | 2 |
| | -Share with relatives and others | 0 | 0 | 0 | 22 | 19 | 9 |
| Rank the livestock according to their importance | -cattle | 50 | 65 | 64 | 66 | 63 | 62 |
| | -Goats | 29 | 17 | 17 | 19 | 19 | 20 |

-Cattle provide more draft power, income, milk, manure, meat per animal than all domestic animals and one is respected in the community (260/270 providing reasons)

-Goats are hardy animals, easy to keep, easy to sell (don't need Govt. officers to inspect before slaughter), don't have problem of storage after slaughter, and provide more meat and income per animal than poultry (50/76 providing reasons)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | -Poultry | 21 | 9 | 19 | 15 | 18 | 18 | -easy to keep and slaughter.<br>-Don't need much space (Mostly on free range)<br>(20/46 providing reason) |
| REPRODUCTIVE DATA | | | | | | | | |
| What percent of calves survived? | | 26 | 43 | 41 | 22 | 62 | 35 | |
| How many died because of diseases? | -East Coast Fever | 32 | 65 | 75 | 38 | 29 | 50 | |
| | -Black Quarter | 33 | 4 | 0 | 38 | 3 | 8 | |
| | -Diarrhoea/ worms | 5 | 0 | 0 | 2 | 2 | 2 | |
| How many were stolen? | | 19 | 0 | 1 | 10 | 5 | 7 | |
| How many were predated? | | 3 | 9 | 8 | 4 | 5 | 6 | |
| Others | | 8 | 22 | 16 | 44 | 52 | 25 | |

MARKETING DATA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| What percent of animals were sold | -This year? | 20 | 11 | 26 | 26 | 30 | 23 |
| | -Less than 5 years ago? | 46 | 47 | 58 | 62 | 46 | 54 |
| | -More than 5 years ago? | 34 | 42 | 16 | 13 | 25 | 23 |
| In which market(s) did you sell the animals | -Produce | 51 | 84 | 33 | 35 | 57 | 46 |

-Can sell at anytime (101/170) providing reasons.

-Only market available (10/170) providing reasons.

-Ceremonial functions (5/170 providing reasons).

-Produce markets locally found (41/170 providing reasons).

-No labor charge for trekking (13/170 providing reasons)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | -Auction | 49 | 16 | 67 | 65 | 43 | 54 | -Better returns (200/230 providing reasons).<br>-Butchermen come and buy at homestead (30/230 providing reasons). |
| Which market did you prefer? | -Produce | 8 | 25 | 3 | 11 | 15 | 10 | -Only market available (16/23 providing reasons). |
| | -Auction | 92 | 75 | 97 | 89 | 85 | 90 | -Higher prices (323/368 providing reasons).<br>-Get cash at once immediately (39/368 providing reasons). |
| Do you know which market offers the highest | -Yes | 94 | 71 | 68 | 68 | 96 | 76 | |
| | -No | 6 | 29 | 32 | 32 | 4 | 24 | |
| Did you choose the market because of price? | -Yes | 68 | 60 | 50 | 75 | 93 | 66 | |
| | -No | 34 | 40 | 50 | 25 | 7 | 34 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| What time of the year did households you sell your animal(s)? | -Jan.-March | 24 | 25 | 33 | 20 | 34 | 26 | -For periods of Jan-March and Oct.-Dec., sold their livestock because they needed money for school fees (8%), food (31%) and pay for medical charges (3%). |
| | -April-June | 6 | 5 | 10 | 10 | 13 | 9 | |
| | -July-Sept. | 37 | 20 | 13 | 30 | 26 | 25 | |
| | -Oct.-Dec. | 33 | 28 | 44 | 40 | 27 | 37 | |
| | -Anytime | 0 | 22 | 0 | 0 | 0 | 3 | -For periods of April-June and July-Sept. households sold their livestock because they wanted to pay back govt. loan (44%) and they knew that this is the time they can get more money at the markets (6%). |
| Do you know the time when the prices are high in all markets? | -Yes | 86 | 68 | 65 | 92 | 79 | 79 | |
| | -No | 14 | 32 | 35 | 8 | 21 | 21 | |
| If the price of livestock increases while the prices of other products, fees, medical charges | -Increase | 14 | 53 | 66 | 63 | 22 | 49 | -For more profits (10% of households interviewed). -For security (3% of households interviewed). |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| remain the same, are you going to increase or decrease sales | -Decrease | 86 | 47 | 34 | 34 | 78 | 51 | -Few animals sold would sufficient funds for the household needs (86% of households interviewed). |
| Were you influenced by season to sell the cattle this year? | -Yes | 22 | 60 | 50 | 60 | 91 | 53 | -Because of drought there was no food (43/81 providing reasons) |
| | -No | 78 | 40 | 50 | 40 | 9 | 47 | -Because there was no food hence the need to sell the the animals (200/208 providing reasons) |
| What sex of cattle is preferred for sale? | -Male | 100 | 100 | 91 | 98 | 91 | 96 | -Larger than females and therefore fetch more money (66% of households interviewed). |
| | -Female | 0 | 0 | 9 | 2 | 9 | 4 | -Females needed for breeding (30% of households interviewed). |
| What age group do to sell (tick one) in years | 2 | 0 | 0 | 7 | 3 | 4 | 3 | |
| | 3 | 0 | 0 | 9 | 5 | 0 | 4 | |
| | 4 | 6 | 2 | 12 | 18 | 0 | 10 | |
| | >5 | 94 | 98 | 72 | 74 | 96 | 83 | -Larger animals hence more money (78% of households interviewed). |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | -They are non-productive (22% of households interviewed). |
| Do you sell the animals only to meet a specific problem? | -Yes | 95 | 75 | 84 | 91 | 79 | 87 | |
| | -No | 5 | 25 | 16 | 9 | 21 | 13 | |
| Which type of livestock do you prefer to sell? (chose one). | -Cattle | 94 | 58 | 64 | 60 | 57 | 57 | |
| | -Sheep | 0 | 2 | 0 | 10 | 0 | 3 | |
| | -Goats | 6 | 40 | 32 | 30 | 31 | 27 | |
| | -Chicken | 0 | 0 | 4 | 0 | 12 | 3 | |
| Which is more important? | -Livestock | 7 | 26 | 17 | 32 | 39 | 23 | -Sell anytime regardless of season (19/190 providing reasons). |
| | | | | | | | | -Get more money from livestock than crops (41/190 providing reasons). |
| | -Crops | 5 | 72 | 81 | 68 | 67 | 60 | -Crops are important for food food and cash (111/190 providing reasons). |
| | | | | | | | | -They complement one another (19?190 providing reasons) depending on season |

DW stands for Dowa West
DE stands for Dowa East
KU stands for Kasungu
MCH stands for Mchinji
NTCH stands for Ntchisi

Appendix B
Table 12

**Table 12. t-test for the mean price per kg cattle differences between seasons of each year.**

| Year | Season | Auction Market Average Price | SD | Produce Price | t-value | P-value |
|---|---|---|---|---|---|---|
| 1991 | growing season | 4.32 | 0.97 | 2.00 | 5.83 | <0.005 |
| | after harvest | 4.70 | 0.54 | 2.00 | 12.27 | <0.005 |
| 1992 | growing season | 4.87 | 0.51 | 2.50 | 11.29 | <0.005 |
| | after harvest | 5.03 | 0.49 | 2.50 | 12.65 | <0.005 |
| 1993 | growing season | 4.77 | 0.98 | 5.00 | -0.58 | >0.100 |